What is claimed is:

Sub A27

1. A digital telemetry system having improved data rate and robustness, comprising:

a data transmission cable having a first end and a second end, and capable of transmitting data on at least two propagation modes;

a data source connected at the first end and having data transmission circuitry to generate data signals on the at least two propagation modes;

a receiver connected to the second end and having

a first receive circuitry to receive signals on a first of the at least two propagation modes;

a second receive circuitry to receive signals on a second of the at least two propagation modes;

an adaptive far-end cross-talk cancellation circuitry connected to the first receive circuitry and to the second receive circuitry.

2. The digital telemetry system of Claim 1, wherein the adaptive far-end cross-talk cancellation circuitry comprises:

a first propagation mode cross-talk adjustment circuit connected to receive samples on a first propagation mode and having circuitry to accept samples from a second propagation mode wherein the first propagation mode cross-talk adjustment circuit adjusts the samples on the first propagation mode by values that are a function of the samples of the second propagation mode.

00707535.057002

3. The digital telemetry system of Claim 2, wherein the far-end adaptive cross-talk cancellation circuitry further comprises:

a slice residual determination logic connected to the output of the cross-talk adjustment circuit;

a cross-talk parameter update logic connected to receive the slice residual from the slice residual determination logic and connected to the cross-talk adjustment circuit.

4. The digital telemetry system of Claim 2, wherein the far-end adaptive cross-talk cancellation circuitry accepts as input one value on each of a plurality of carriers and computes the cross-talk component for each carrier.

5. The digital telemetry system of Claim 4, wherein the far-end adaptive cross-talk cancellation circuitry computes the cross-talk component for each carrier by multiplying the signal received on the second propagation mode by a carrier specific coefficient.

6. The digital telemetry system of Claim 5, wherein the far-end cross-talk parameter update logic updates each carrier specific coefficient as a function of the slice residual on such carrier.

7. The digital telemetry system of Claim 5, wherein the far-end cross-talk parameter update logic updates each carrier specific coefficient by applying the equation:

$$CXYi = CXYi + AlphaFEXT * (< CEXi, CEXi > / REF\_MAGN^2) * < TXFFT\_out[i], TYresidual[i] >$$

where

CEXi is the frequency domain equalizer coefficient for the ith carrier of propagation mode X;

CXYi is the cross-talk cancellation coefficient for the ith carrier for cancelling far-end cross-talk from propagation mode X to propagation mode Y;

AlphaFEXT is a constant for balancing the tracking speed of CXYi against the stability of the value of CXYi;

REF_MAGN is the RMS magnitude of the reference data points;

TXFFT_out[i] is the frequency domain data point on the ith carrier on propagation mode X;

TYresidual[i] is the slice residual for the ith data point on the Y propagation mode.

8. The digital telemetry system of Claim 2, wherein the far-end cross-talk adjustment circuit receives *m* samples from the second receive circuitry and convolves these using *m* coefficients.

9. The digital telemetry system of Claim 8, further comprising a slice determination logic and a coefficient update logic wherein the *m* coefficients are adjusted as a function of a slice residual determined by the slice determination logic.

10. The digital telemetry system of Claim 9, wherein the *m* coefficients are adjusted using the equation:

$$CXYi = CXYi + AlphaFEXT * (< CEXi, CEXi > / REF\_MAGN^2) * < TY_{(n-i)}, TXresidual >$$

where,

CEXi is the *ith* time domain equalizer coefficient of propagation mode X;

CXYi is the *ith* cross-talk cancellation coefficient for canceling far-end cross-talk from propagation mode X onto propagation mode Y;

TYj is the *jth* sample from the second receive circuitry coefficient of propagation mode Y;

TXResidual is TXCorr - TXIdealPoint

where TXCorr is the cross-talk corrected output from the cross-talk adjustment circuit and TXIdealPoint is an ideal constellation point for propagation mode X; and

AlphaFEXT is a constant between 1 and 0.

11. The digital telemetry system of Claim 10, wherein AlphaFEXT is in the range 0.001 to 0.00001.

12. A method of digital telemetry having improved data rate and robustness by canceling far-end cross-talk from a near-lying propagation mode, comprising:

inputting a first sample on a first propagation mode;

inputting a second sample on a second propagation mode;

determining a cross-talk component from the second sample; and

determining an output by subtracting the cross-talk component from the first sample.

13. The method of digital telemetry having improved data rate and robustness by canceling far-end cross-talk from a near-lying propagation mode of Claim 12, further comprising:

determining the slice residual; and

adjusting a function used to determine the cross-talk component as a function of the slice residual.

14. The method of digital telemetry having improved data rate and robustness by canceling far-end cross-talk from a near-lying propagation mode of Claim 13, wherein the cross-talk component is determined by multiplying a carrier specific coefficient with a sample received on a corresponding carrier on the near-lying propagation mode.

15. The method digital telemetry having improved data rate and robustness by canceling far-end cross-talk from a near-lying propagation mode of Claim 14 wherein the coefficients are updated by applying the function:

$$CXYi = CXYi + AlphaFEXT * (< CEXi, CEXi > / REF\_MAGN^2) * < TXFFT\_out[i], TYresidual[i] >$$

where

CEXi is the frequency domain equalizer carrier for ith carrier of propagation mode X;

CXYi is the cross-talk cancellation coefficient for the ith carrier for canceling far-end cross-talk from propagation mode X to propagation mode Y;

AlphaFEXT is a constant for balancing the tracking speed of CXYi against the stability of the value of CXYi;

REF_MAGN is the RMS magnitude of the reference data points;

TXFFT_out[i] is the frequency domain data point on the ith carrier of propagation mode X;

TYresidual[i] is the slice residual for the ith data point on the Y propagation mode.

16. A method of digital telemetry having improved data rate or robustness by canceling far-end cross-talk from a near-lying propagation mode, comprising:

inputting a first set of samples on a first propagation mode;

inputting a second set of samples on a second propagation mode;

determining a cross-talk component by convolving the second set of samples; and

determining an output by subtracting the cross-talk component from a first sample on the first propagation mode.

17. The method of Claim 16 wherein the convolving comprises multiplying each sample in the first second set of samples by a coefficient.

18. The method of Claim 17 further comprises:

determining a slice residual between the output and an ideal point;

adjusting the coefficients as a function of the slice residual.

19. The method of Claim 18 wherein the coefficients are adjusted by the equation:

$$CXYi = CXYi + AlphaFEXT * (< CEXi, CEXi > / REF\_MAGN^2) * < TY_{(n-i)}, TXresidual >$$

where,

CEXi is the ith time domain equalizer coefficient for propagation mode X;

TYj is the *jth* sample from the second receive circuitry of propagation mode Y;

TXResidual is TXCorr - TXIdealPoint

where TXCorr is the cross-talk corrected output from the cross-talk adjustment circuit and TXIdealPoint is an ideal constellation point for propagation mode X; and

AlphaFEXT is a constant between 1 and 0.

20. The method of Claim 19 wherein AlphFEXT is in the range 0.001 to 0.0001.